



U.S. DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
NATIONAL WEATHER SERVICE  
Silver Spring, Md. 20910

May 14, 1985

WOTS141: HGH

**TO:** All NWS Regional Headquarters, Area Electronics Supervisors,  
and Electronics Technicians (EHB-7 Distribution)

**FROM:** WOTS1 - J. Michael St. Clair *J. M. St. Clair*

**SUBJECT:** Transmittal Memorandum for Engineering Handbook No. 7, Issuance 85- 3

1. Material Transmitted:

Engineering Handbook No. 7, Communications Equipment, Section 3.4,  
Modification Note 21: NOAA Weather Radio (NWR) Transmitter Sites  
Lightning Protection.

2. Summary:

Modification Note 21 incorporates changes at all NWR transmitter sites  
regardless of the manufacturer of these transmitters. The implementation  
of this modification will be on a priority basis determined by the  
communications program manager.

NOTE: The owner of the tower must give permission for this installation.

3. Effect on Other Instructions:

None.

4. Certification Statement:

This modification has been successfully field tested at Beaumont, Texas.

5. Reporting Modification to WSH Engineering Division:

Target date for this modification will not be provided since  
implementation on all systems will extend over a 3-year period.

All completed equipment modifications shall be reported on the Form H-28  
(see attached exhibit), Engineering Progress Report, according to  
instructions contained in EHB-4, Part 2. Report as Mod. 21. for either  
B220 or B222, as appropriate.

EHB- 7  
Issuance 85- 3

CC:  
All Regional Facilities Engineering Branches



COMMUNICATIONS EQUIPMENT MODIFICATION NOTE 21  
(For Electronics Technicians)

SUBJECT : NOAA Weather Radio Transmitter Lightning Protection

PURPOSE : To provide lightning protection to all NWR Transmitters

EQUIPMENT AFFECTED : All NOAA Weather Radio Transmitters

PARTS REQUIRED : There are three separate kits that make up the complete modification. They are listed in the order in which they will be discussed in the text.

I. Transmit Coax-Shield Grounding

Parts supplied with the Transmit Coax-Shield Grounding Kit are as follows:

Qty	Description	Part No.
1	Clamp, Worm Drive, 3"	3757-034
1	Clamp, Worm Drive, 8"	3757-035
1	Flat Washer, 1/4-20	H13006
1	Nut, Hex, 1/4-20	H13000
1	Lock Washer, Split	H13003
1	Screw, Phillips, 1/4-20 x 1.5"	H13244
1	Lug, Ground	NA
1	Strap, Braided Copper, 22" x 1"	NA

II. AC Arrester/Protector Installation

Parts supplied with the AC Arrester/Protector Installation Kit are as follows:

Qty	Description	Part No.
1	Arrester, Lightning, AC	3757-038
1	Hub	3757-104
4	Terminal Crimp (Burndy #YAV8C-L1)	3757-106

## III. Audio Line Protector Installation

Parts Supplied with the Audio Line Protector Installation Kit are as follows:

Qty	Description	Part No.
1	Protector, Signal Line	3757-040
3	Lock Washer, Ext. Tooth	H10007
3	Screw, Phillips, #10 x 5/16"	H10054
1	Phone Wire (30") with/Crimp Terminals	W09001

There are additional supplies that are required for these installations. The supplies are normally on station. If they are not on hand at the station, they must be procured locally.

1 ea. - Coarse steel wool  
 1 ea. - Durable waterproof compound - Dow  
           Corning #732 RTV (clear) Silicone Rubber  
           Adhesive/Sealant (or equivalent)  
 1 ea. - Waterproof strap - 3M #77 spray adhesive  
          (or equivalent)

MOD PROCUREMENT : Kits will be sent directly to sites on a priority basis as determined by the communications program manager.

SPECIAL TOOLS REQUIRED : 1 ea. - Knife  
 1 ea. - Screwdriver, 3/8" blade  
 1 ea. - Screwdriver, #3 Phillips  
 1 ea. - Metal snippers  
 1 ea. - Drill and 1/4" bit  
 1 ea. - Nut Driver, 7/16", hollow shaft

TEST EQUIPMENT REQUIRED : None.

TIME REQUIRED : 8 work hours

General:

Installation procedures are covered in the Procedures section under these three headings:

- I. Transmitter Coax-Shield Grounding
- II. AC Arrester/Protector Installation
- III. Audio Line Protector Installation

It is recommended that all three of these procedures be completed as one installation. This ensures that when the transmitter resumes operation, protection will immediately apply to all three areas: transmission line, AC power line, and audio line.

The Theory section briefly describes the protective capabilities of the installed circuits.

The Maintenance section provides important data describing the checkout/replacement of affected parts after excessive stress, due to lightning or other influence.

The instruction concludes with a Parts Ordering section which provides a listing of maintenance parts and parts ordering information.

Procedure:

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\*WARNING\*  
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When power is present, voltages dangerous to life exist within the equipment and along the transmission line to the antenna.

Transmitter must be in OFF condition, and AC Primary power must be disconnected from transmitter before starting any of these installation procedures.

All these procedures are to be performed by qualified personnel. Operations which require climbing of the tower must be performed by professional riggers qualified in performing this type of installation work. Arrester installation (Procedure II) must comply with local electrical power installation codes, and must be installed by a licensed electrician. The participation of a facilities technician or construction representative in performing this modification is strongly recommended.

## I. Transmit Coax-Shield Grounding

1. Turn transmitter OFF.
2. Disconnect AC primary power from transmitter.
3. Determine correct coax shield grounding location using Figure 1 as a guide. Ground strap should be attached to the coax at the point where the coax begins its turn off of the tower. Once connected, the ground strap should make a straight, short, vertical run to the tower leg. The best ground strap run is a compromise between a vertical run and a short run.
4. Cut and remove a 1-1/2 inch section of coax cable jacket (see Figure 2).

NOTE 1

Take care to avoid gouging or crushing the cable.

5. Clean the exposed surface of the shield (outer conductor) with steel wool until the surface is clean and bright. Also, clean one inch of the outer coax jacket above and below the exposed shield.

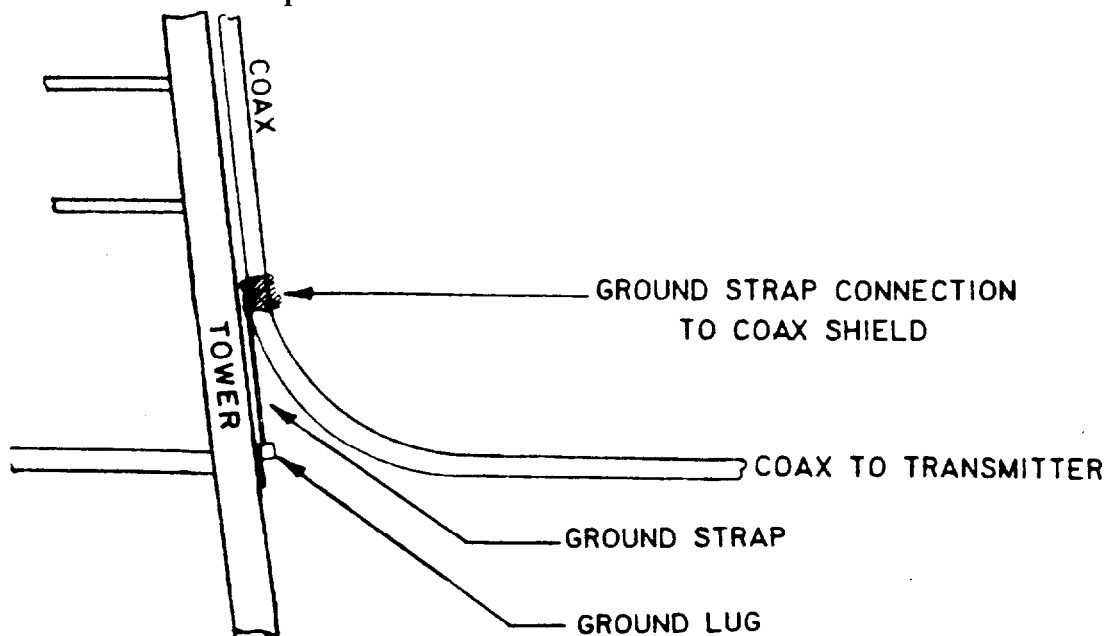
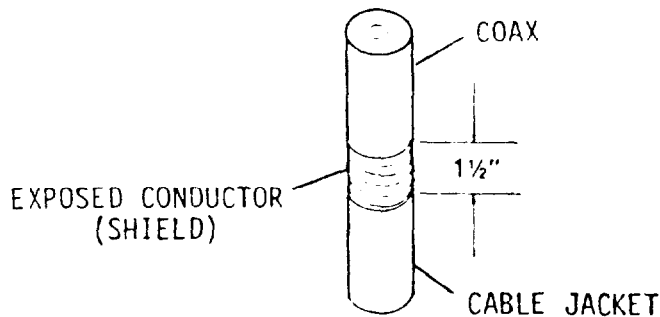
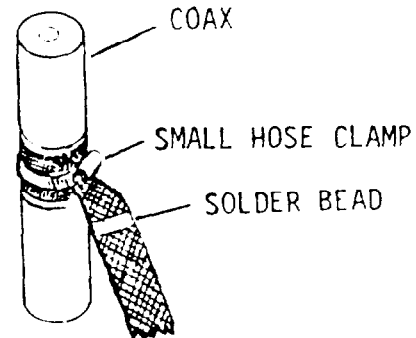


Figure 1

Figure 2Figure 3

6. Wrap 1-1/2 turns of the flexible end of the ground strap around the exposed shield and then fold the trailing end of the strap at a right angle to run parallel to the cable. Secure the strap with the adjustable hose clamp (see Figure 3). Tighten the clamp snugly for a good electrical connection, but not so tight as to damage the cable. The solder bead should be located approximately one inch from the hose clamp. This bead is necessary to keep moisture from migrating up the ground strap to the coaxial cable connection.
7. The coax shield/ground strap connection, Figure 3, must be thoroughly water-proofed as follows:
  - a. Snip off all but about 3/4 inch of the clamp's excess "track."
  - b. Use the supplied heavy sealing tape to cover connection area (clamped ground strap, clamp, etc.). Sealing tape material can be stretched slightly and formed, to completely encase the connection area. Keep tape surface clean.
  - c. Use plastic electrical tape to over-wrap the entire connection. Also, run this wrap along the cable jacket for 1 inch on each side of connection and wrap down along ground strap to the solder bead, Figures 4 and 5. Keep the tape-wrap snug, and overlap successive turns by about one-half. Wrap with at least two full layers of tape.

- d. Over-spray thoroughly with waterproof strap -- 3M #77 -- or equivalent waterproofing (not supplied).
8. Proceed to step 9 if tower is angle-iron construction; proceed to step 13 if tower is round-legged (tubular) construction.
9. The grounding procedure for an angle-iron tower is accomplished by drilling a hole in the tower leg and connecting a lug to the tower. Locate the correct ground point on the tower. This point should be so that the ground strap is nearly vertical and as short as possible. Then drill a 1/4 inch hole through structure for mounting the ground lug (see Figure 4).

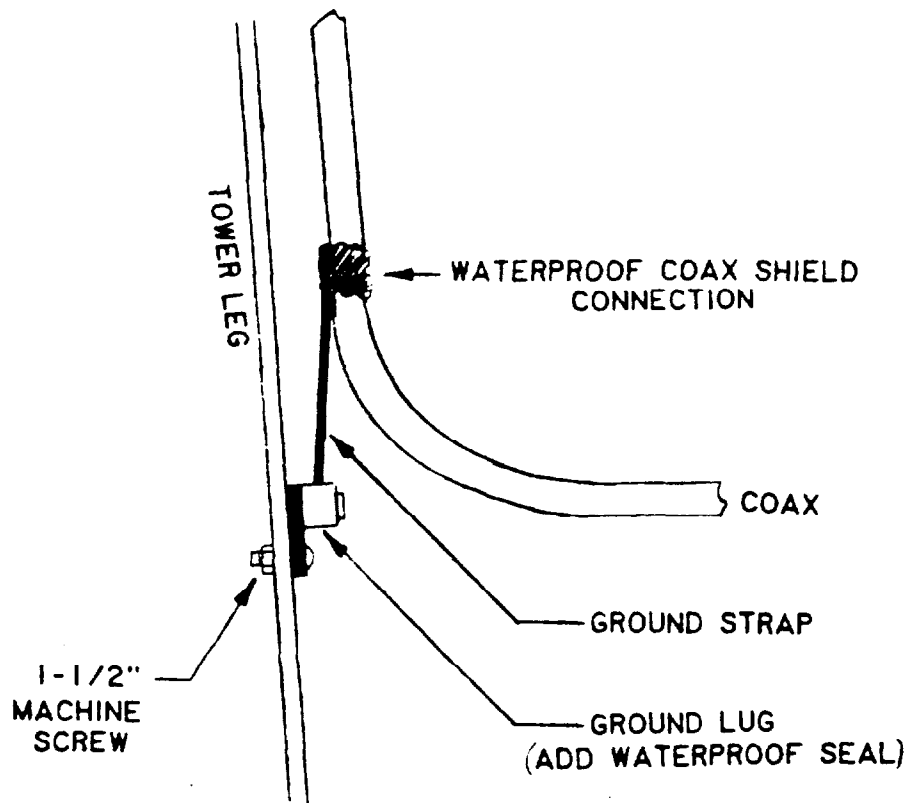


Figure 4

10. Clean surface thoroughly to bare metal for 1/2 inch radius around ground lug mounting hole. The tower leg surface must be clean of any paint, rust, or oxidation for good electrical contact. Also, remove contaminants, rust, deteriorated paint from around exposed tower leg surface. A clean surface is necessary for waterproofing.
11. Secure ground lug at mounting hole with 1-1/2 inch stainless machine screw. Flat washer, lock washer, and nut are used in that order with the screw.
12. At this point, the coax should be refastened to the tower leg if not yet done. Cut the ground strap to correct length if necessary. Insert the strap material into ground lug (doubled over) and tighten strap screw. Return to step 7 for waterproofing. Then proceed to step 17.
13. The grounding procedure for a round leg tower is accomplished by using a ground lug connection to an exposed spot on the tower leg and held in place with a hose clamp. For this procedure we recommend NO DRILLING be done. Locate the correct ground point on the tower. This point should be so located that the ground strap is nearly vertical and as short as possible (see Figure 5).
14. Clean surface thoroughly to bare metal for 1/2 inch radius around the selected ground point. The grounding surface must be clean of any paint, rust, or oxidation for good electrical contact. Also remove contaminants, rust, or deteriorated paint from exposed tower surface. A clean surface is necessary for waterproofing.
15. Clamp the ground lug to the exposed surface of the tower with the large stainless hose clamp as illustrated in Figure 5.
16. At this point the coax should be refastened to the tower leg if this has not been accomplished yet. Cut the ground strap to correct length, as necessary. Insert the strap material into ground lug (doubled over) and tighten strap screw.
17. To inhibit oxidation at the tower's new round lug terminal (both angle-iron and round-legged towers) use a durable, silicone rubber exterior-type sealant (not supplied) to entirely coat and encase the contact area.



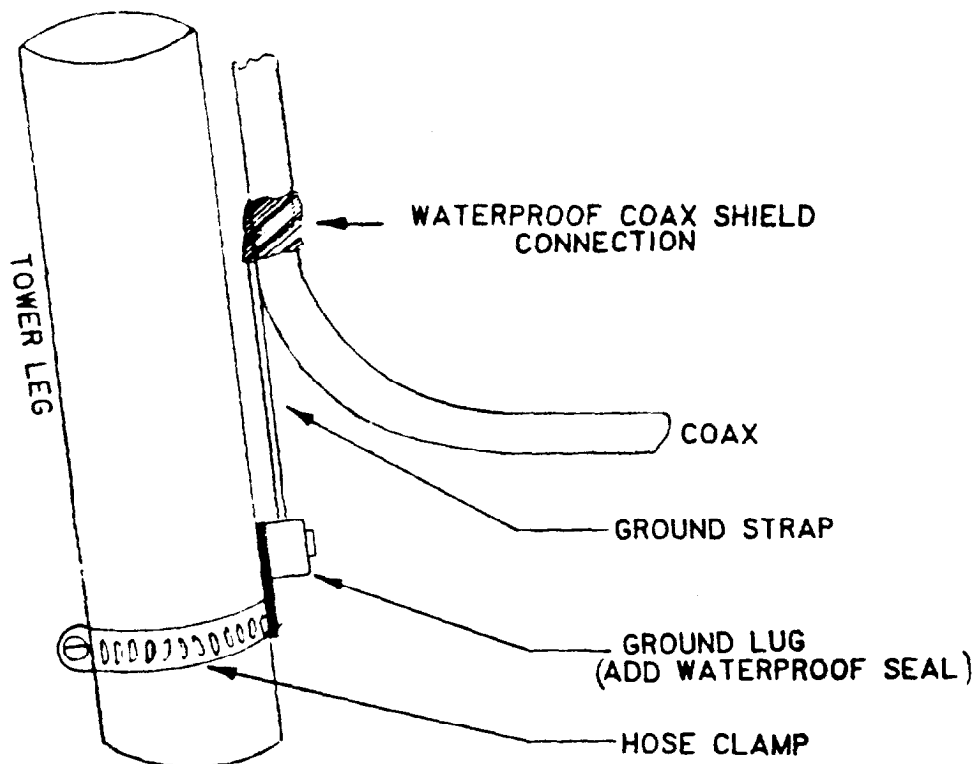


Figure 5

18. This completes the procedure for Transmit Coax-Shield Grounding.

## NOTES 2 AND 3

For new transmitter installation, have rigging crew perform grounding of coax shield and waterproofing of ground connections at upper-tower location and at tower base.

For an existing transmitter installation, ground the coax shield at the tower base. Later, when a professional rigger is present for other high tower work, have upper coax shield ground added.

## II. AC Arrester/Protector Installation

NOTE 4

This installation procedure must be performed in compliance with all local electrical code requirements. Have these procedures carried out by a qualified, licensed, electrician.

Arrester Installation Notes.

The effectiveness of the arrester is directly dependent on the quality of the installation. The optimum point for electrical connection of the arrester is the point in the feeder circuit where the overcurrent devices (fuses/circuit breakers) used to protect the transmitter branch circuit receive their supply. An additional requirement for connection of the arrester is that the connection point hardware (breaker panel supply terminals, junction box terminals, etc.) be suitable for connection of the required #8 arrester conductors and any other conductors connected at the point. This in itself may be a limiting factor for installation of the device. In general the arrester can be installed on the supply side (feeder) terminals of the circuit breaker panel that supplies power to the transmitter(s). In all cases, connect the arrester to the portion of the feeder circuit that uses large diameter wires (#10 or larger) to deliver AC power to the transmitter(s).

Procedure for 220 VAC, Single Phase

The arrester is self-contained and installation is made, electrically, in parallel with power load, as shown in Figure 6.

1. Ensure that the transmitter is turned OFF.

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\*WARNING\*  
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When AC power is present, voltages dangerous to life exist within the equipment.

2. Ensure that AC primary power to transmitter is disconnected at power source distribution network, Figure 6.

## 220 VAC SINGLE PHASE

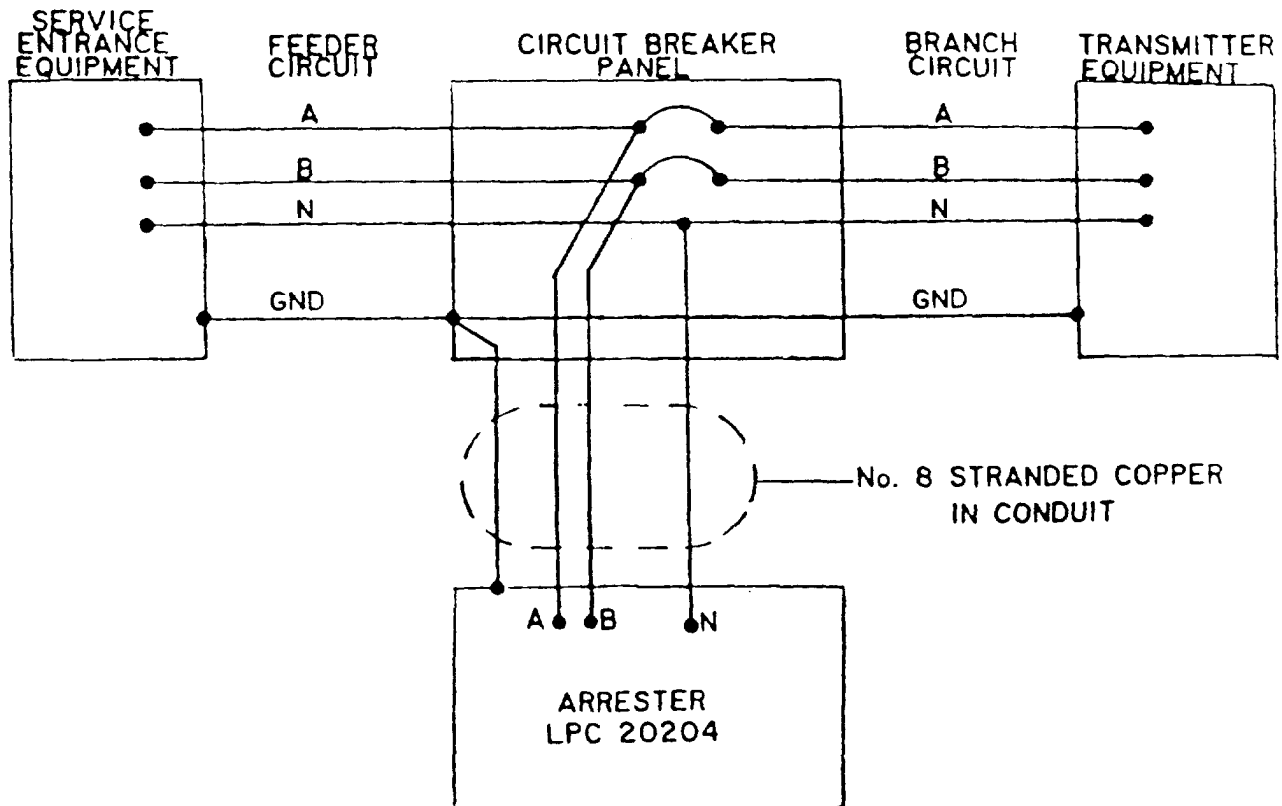


Figure 6

NOTE 5

The length of the #8 power wires between the arrester and the feeder circuit must be as short as possible. The effectiveness of the arrester is diminished as the length of connecting wires increases. The arrester should be mounted as close to the transmitter as possible.

3. Refer to Figure 9. Mount the arrester using the four 5/16-inch diameter mounting holes. Remember that the installation of conduit greatly affects the location of the arrester and must be taken into account when mounting.

### Three Phase Installation Problems

When installing the lightning arrester on a three phase circuit ensure that both Transmitter #1 and Transmitter #2 are fed from the same phase. If the transmitters are not fed from the same phase a problem occurs in that the lightning arrester can only protect two 110 volt phases. In the event that the transmitters are wired AB/BC as illustrated in Figure 7, one phase of one transmitter would not be protected. In cases such as these take the time to resolve this problem by rearranging the circuit breakers or the wiring within the panel box. Install arrester per Figure 6.

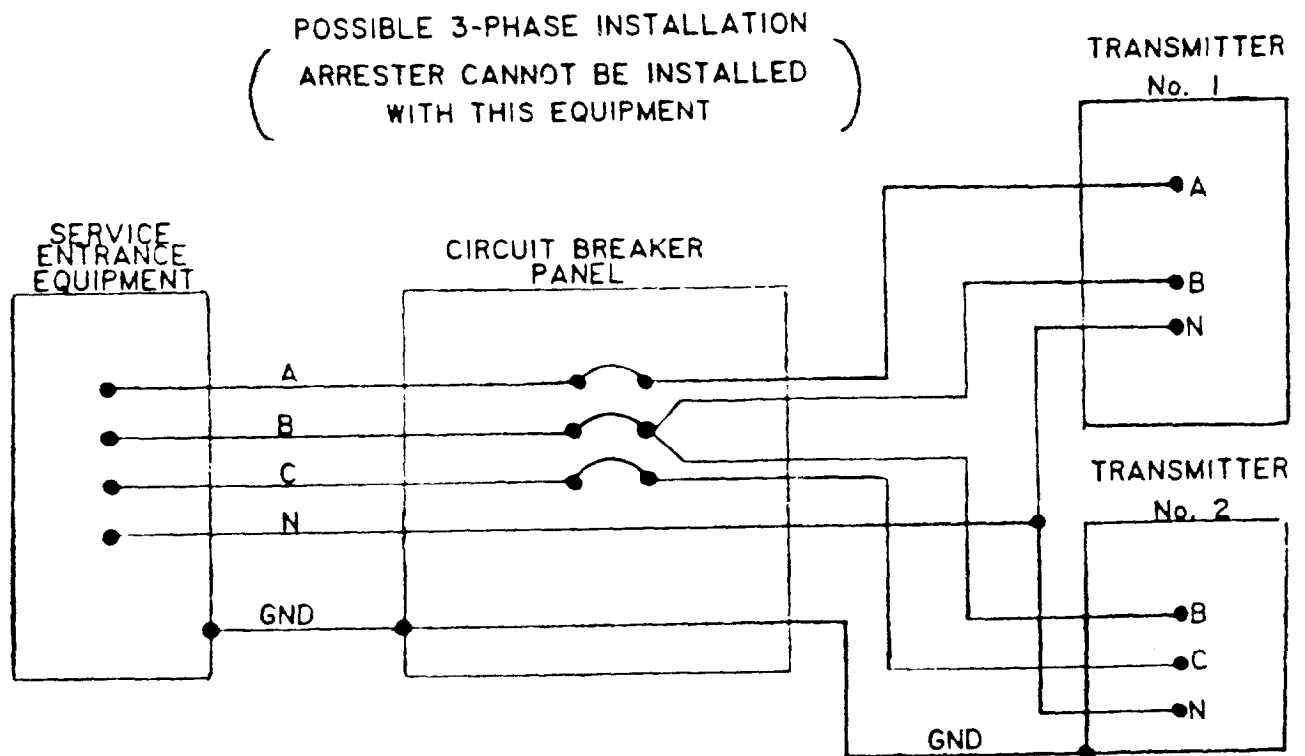


Figure 7

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Procedure for 110 VAC, Single Phase

Connect the single hot lead (phase) to both "A" and "B" connection on the AC Arrester/Protector Unit; this provides double protection. The A and B phases operate in parallel to protect the same phase.

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 \*CAUTION\*  
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In the process of installing the #8 power wires and making connections inside the arrester enclosure, do not disturb the fuse wires under the cable tray or reposition other small-gauge wires.

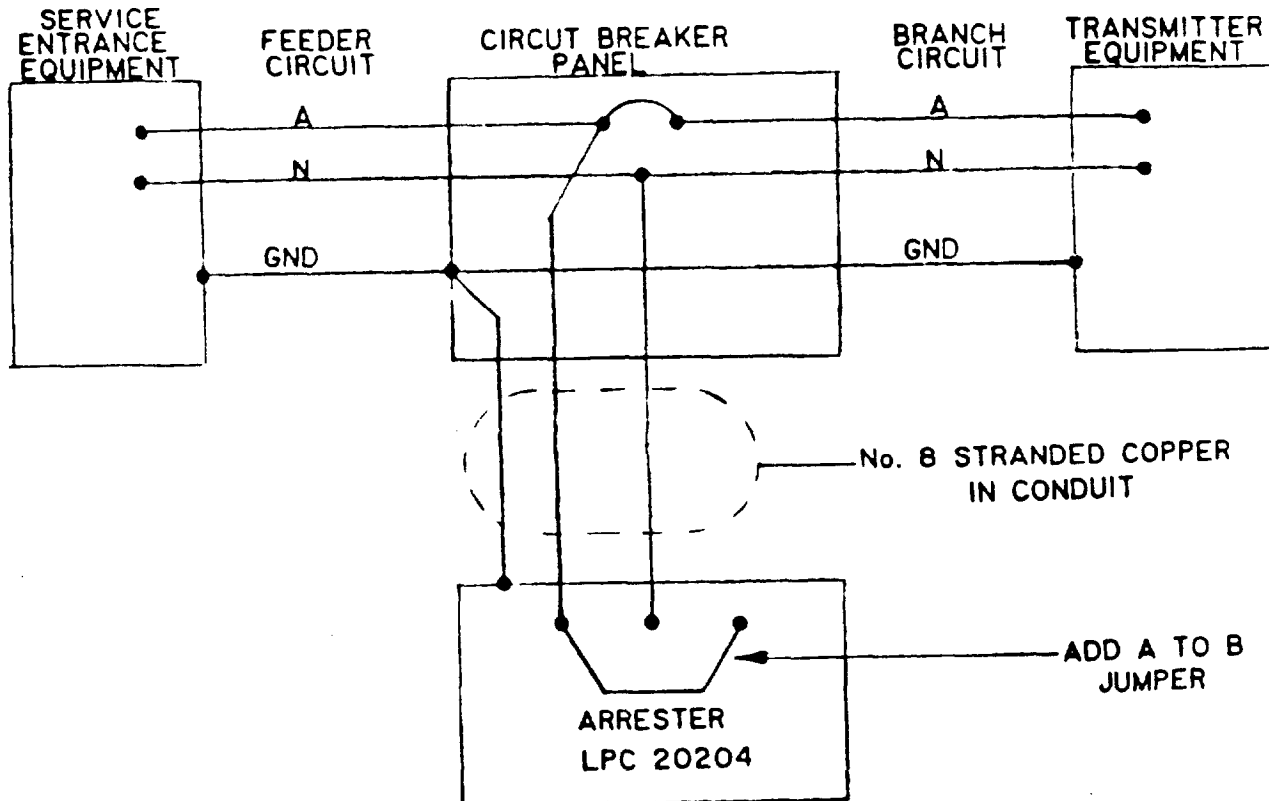
110 VAC INSTALLATION

Figure 8

4. Refer to Figure 10. Connect arrester to power bus with #8 stranded copper, Type TW, building wire. Terminate the "A," "B," and "N" power wires at the arrester end using crimp terminals (Burndy "Hylug" type YAV8C-L1 #8 stranded wire, with 1/4-inch single hold, or equivalent). Bolt these crimp terminals to the appropriate A, B, and N, studs using the nut and split lockwasher provided on the stud. Place the A and B power wires in the curved cable tray.

#### NOTES 6 AND 7

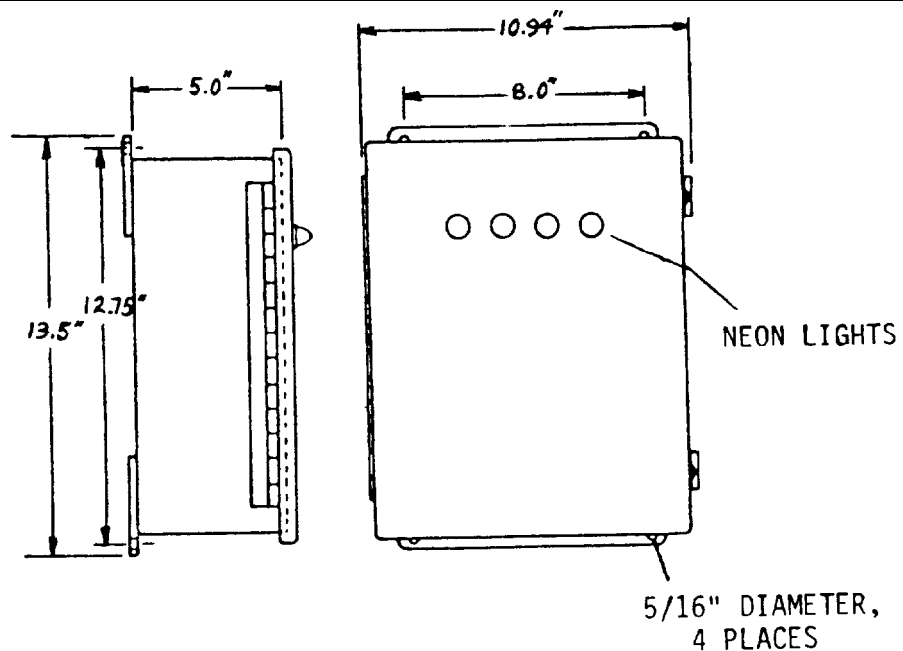
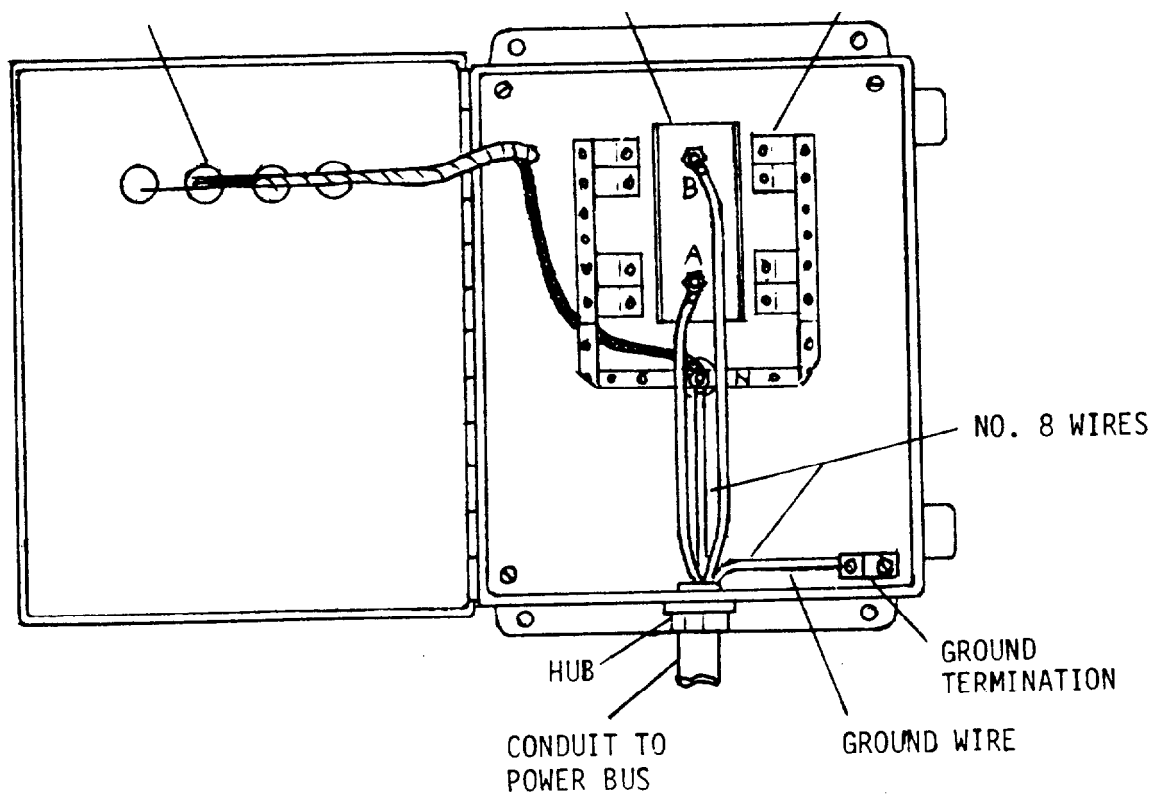
Electricians like to leave excess (loose) wire in power panels. Be sure not to let this happen.

Before power is applied check to be sure there is sufficient clearance between the front panel lamps and the "B" wire connection.

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\*CAUTION\*  
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A and B power wires are permitted only in the arrester cable tray. These wires must be short and straight inside the arrester enclosure. No excess wire or loops are permitted.

5. This completes the installation procedure for the AC Arrester/Protector.

**Figure 9****Figure 10**

## III. Audio Line Protector Installation

Protector Installation

The protector is designed to limit voltage transients that appear on audio lines by momentarily shorting the audio lines to a ground through the protector's case. For our installation, we have chosen the transmitter cabinet as the ground because the transmitter circuits are also referenced to the cabinet. This should afford the needed protection. Normally, audio lines, particularly telephone lines, operate in a differential mode where the audio is supplied as a difference in voltage between the two audio lines. Usually, noise or AC that appears on audio lines is induced equally onto both lines and any noise voltage exists between either line and ground and not differentially between each line. The use of differential audio lines permits noise free transmission because noise voltages between either line and ground can be easily isolated from the transmitter by use of an isolation transformer; which is indeed provided in the transmitter remote control panel. Unfortunately, audio line noise which becomes referenced to the transmitter cabinet (ground) is transmitted as audio. This problem has been experienced when installing the protector because the protector deliberately references each audio line to the transmitter cabinet (for protection). This problem is only experienced where noise voltages exist between the audio lines and the transmitter cabinet. Where audio lines are clean with respect to the transmitter cabinet, audio noise will not be experienced. Installations must be checked and noise voltages eliminated before installation of the protector is attempted.

1. Ensure that transmitter is turned OFF.

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*WARNING*  
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When AC power is present, voltages dangerous to life exist within the equipment.

2. Ensure that AC primary power to transmitter is disconnected at power distribution panel.
3. Remove two cover screws and four assembly screws holding Protector assembly together, Figure 11.



4. Refer to Figures 11 and 12 and note that backer plate of Protector assembly attaches to suitable mounting holes on top rail inside transmitter cabinet.
5. Exterior surfaces of both the transmitter cabinet and the protector backer plate must be scraped to bare metal around the three mounting holes, refer to Figure 12.

NOTE 7

Mount Protector assembly, Figure 11, such that line connections are toward rear and load connections (with connecting cable) are toward front of cabinet.

6. For backer plate mounting, Figure 12, use three #10, 5/16-inch machine screws. For each screw, place a #10 star washer between backer plate and the mounting rail. Secure backer plate to rail by tightening screws.
7. Mount Protector assembly on backer plate (4 screws) and attach Protector cover to the assembly (2 screws)
8. Refer to Figure 11 and connect Protector cable to TB1 on the SR-402RA Remote Unit. Red and black wires connect to TB-1, -2 and bare ground wire connects to TB1-5.
9. Connect audio-line input pair to line side of Protector assembly, terminals 1 and 2; connect ground/shield to terminal G.

NOTE 8

Check that there is sufficient deviation/audio level on the transmitter after installing Protector.

10. This completes the installation procedure for the Audio Line Protector.

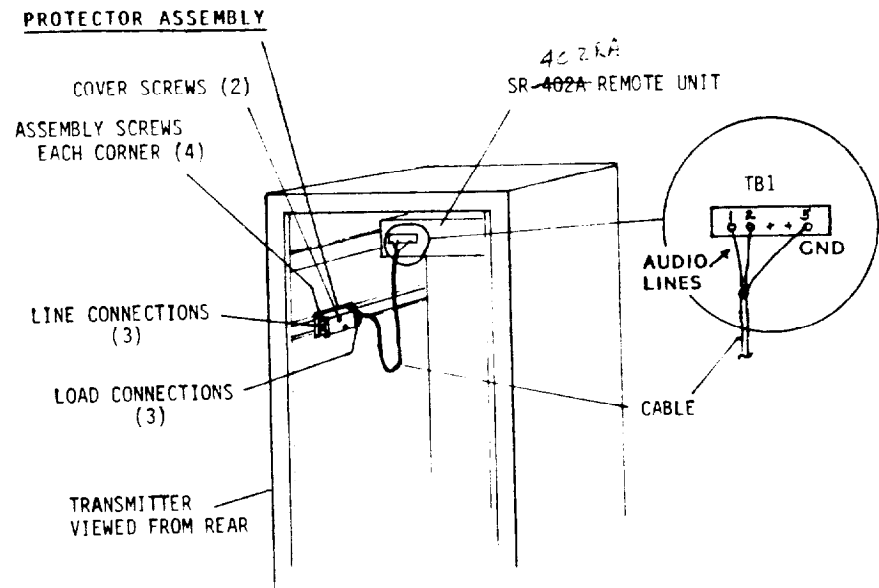
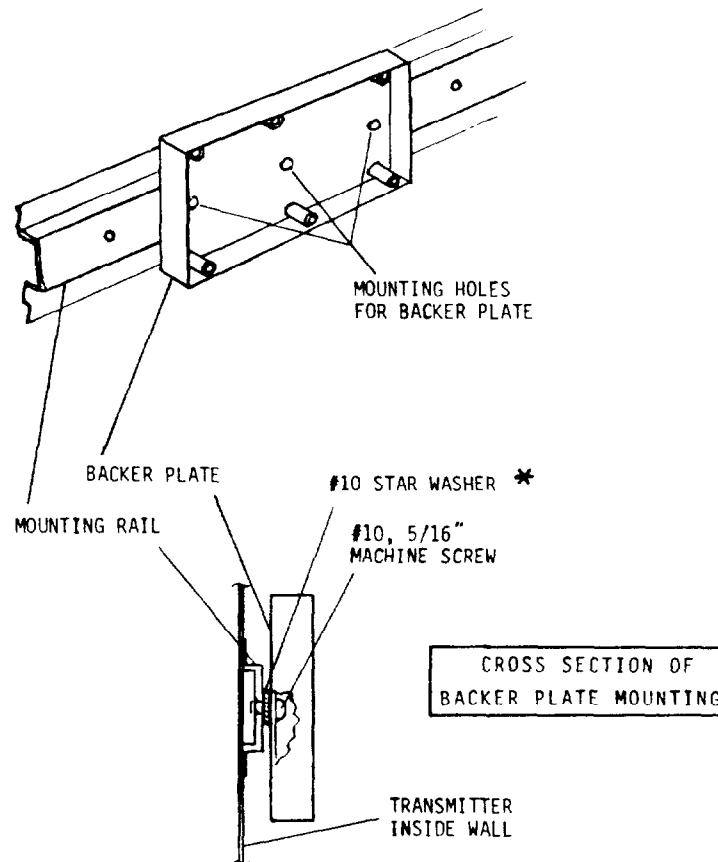


Figure 11



\* SCRAPE TO BARE METAL AROUND MOUNTING HOLES ON RAIL & BACKER PLATE, WHERE STAR WASHERS SEAT

Figure 12

REAPPLYING SYSTEM POWER

Upon completion of all installation procedures, per preceding paragraphs, I, II, and III, apply power as follows:

1. Reconnect AC primary power to transmitter.
2. With AC power applied, observe the Arrester unit. All four panel lights should be lit when this unit is monitoring the active AC line. Proceed to Maintenance Section if panel lights are not lit.

THEORYAC Arrester/Protector

The arrester is automatically operational when connected to the power bus. Lit neon lamps indicate that the power is on and that the arrester is in working order. Two lamps, in parallel, per power leg are provided. Any single lamp unlit indicates that the arrester is operational, but that the lamp should be replaced (NE51). Both lamps unlit indicates that the power is off, or both lamps need to be replaced, or the arrester is no longer functional. The arrester has no moving parts, is on duty at all times, and requires no maintenance unless the indicator lamps are out, or any arrester element has burned out.

Each of the four parallel arrester elements per power leg are individually fused using a special alloy fuse wire. The fuses are factory matched to the arrester elements; each of the four elements of a power leg are factory matched to each other. The fuses burn out only when the arrester elements are damaged. However, for the rated duty of the arrester, it is unlikely that fuse/elements will burn out. Consult Maintenance section for information on fuse/element replacement.

Audio Line Protector

This unit protects audio lines from transient over-voltages caused by lightning, heavy machinery, elevator motors, generators, etc. The protectors interface between the signal lines and the sensitive circuit to provide a sophisticated blend of high speed (nanoseconds) voltage limiting and brute force protection. The signal line protectors recover automatically after an over-voltage condition in preparation for further protection. The audio line protector does not contain any servicable parts. Therefore, if the protector fails it must be replaced as a unit. Consult parts ordering section for ordering information.

Cable Shield Grounding to Tower

The cable shield is connected to the tower leg to prevent the extremely high lightning induced currents from causing damage. Since lightning seeks the lowest resistance path to ground, connecting the cable shield to the tower will help to bypass some of the high currents to the tower's grounding system before equipment damage can occur.

MAINTENANCE

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\*WARNING\*  
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When power is present, voltages dangerous to life exist within the equipment and along the transmission line to the antenna.

Transmitter must be OFF and AC primary power must be disconnected from transmitter before starting any of the maintenance activities.

Coax-Shield Grounds

It is recommended that when the transmitting facilities are shut down for maintenance, such as routine annual maintenance, that the physical connection of the ground contact with the tower structure be checked, cleaned, and resealed as necessary. The integrity of such connections is very important to the operation of the protective ground path.

AC Arrester/Protector

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\*WARNING\*  
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Transmitter must be OFF and AC primary power must be disconnected from transmitter before the cover of the Arrester Unit is opened.

Lamp Replacement - Replace lamps when burned out (contact Scientific Radio for replacement lamps). Both lamps out on a power leg may mean both lamps are burned out. To replace: unscrew lens, depress lamp and turn counterclockwise to remove. Insert new lamp and replace lens.

Fuse Checkout - If lamps check good but do not light, disconnect AC primary power and then inspect fuses.

Burned-out fuses of a power leg indicate that the arrester needs repairs. Fuse/arrestor elements can be replaced by using the following procedure:

1. Open unit cover and remove "A" and "B" wire connections from center posts using 7/16 inch hollow shaft nut driver.
2. Remove remaining 7/16 inch nuts and lift the PVC channel off of center posts.
3. Using a Phillips head screwdriver remove heavy ground strap material from the outside of the fuse elements to be replaced.
4. The individual fuse elements can then be removed from the unit chassis by loosening the chassis retaining screws. Since the fuse elements are slotted, both retaining screws do not have to be removed.
5. Reinstall the new fuse elements by reversing the above procedure. Remember that the fuse elements are matched sets and care must be taken not to mismatch the sets.

#### NOTE 9

A burned-out fuse occurs when the arrester elements have failed. Fuse/element combinations are matched sets. Consult Scientific Radio, as listed under "Parts Department" for replacement sets.

#### Audio Line Protector

The audio line protector contains no servicable parts; if the unit should fail it must be replaced with a working unit.

PARTS ORDERING

Order replacement parts from the following listing. Common items of hardware/supplies are not listed; they are considered local purchase items. To contact factory, refer to address and telephone information given under Parts Department heading.

ITEM	DESCRIPTION	QUANTITY	PART NO.
	<b>ANTENNA GROUNDING KIT</b>		
1	Cablewave Packet (w/gnd strap, gnd lug terminal, sm hose clamp, elec. tape, sealing tape)	1 set	713727-004
2	Hardware, stainless gnd lug mounting (Phillips mach screw #8, 1-1/2" w/ washers and nut)	1 set	
3	Hose clamp, stainless, 32" x 9/16"	1 set	
	<b>ARRESTER/PROTECTOR</b>		
4	Arrester/Protector Unit, 120/240V	1	LPC-20204
	<b>AUDIO LINE PROTECTOR</b>		
5	Protector Unit (w/attached load-connection cable and attaching hardware)	1	DLP-1648

**PARTS DEPARTMENT**

**Telephone Contacts:**

**Business Hours: (716) 235-0920**

**All Other Times: (716) 436-6280  
(Answering Machine)**

**Mailing Address:**

**Scientific Radio Systems, Inc.  
367 Orchard Street  
Rochester, NY 14606**

**Attn: NWS PROGRAM OFFICE**